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AUTHOR Chambers, Jay G.; And Others
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ABSTRACT

This booklet is divided into five sections. The first discusses the differences between education costs and education expenditures and the alternative ways that education costs can be measured. The second section shows how economic analysis can be used to isolate and measure the factors that cause differences in education costs. Section three presents the economic framework that is used to construct the cost indices, discusses the cost indices that were developed, and analyzes the effect of their use on the distribution of state equalization aid. The last section summarizes some of the issues raised by the study and suggests some policy implications of the results. An appendix presents a brief review of previous research on cost-of-education indices. (Author/JD)

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COST-OF-EDUCATION INDICES AMONG SCHOOL DISTRICTS

An Application to the State of Missouri

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Report No. F76-3

Prepared by
Jay G. Chambers, Allan Odden and Phillip E. Vincent

Education Finance Center
Department of Research and Information

Education Commission of the States
1860 Lincoln Street
Denver, Colorado 80295

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Jay G. Chambers is assistant professor of Education and Management (Economics) at the University of Rochester. Allan Odden is director and Phillip E. Vincent is senior economist at the Education Finance Center of the Education Commission of the States.

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INTRODUCTION

At the center of much of the recent debate over school finance reform are the issues of equalization and equity. Judicial and legislative attempts have been initiated in many states to produce distributions of state aid that achieve greater equalization for differences in per pupil tax bases among school districts. A major purpose has been to reduce or eliminate the differences in the quality of education services offered across local school districts as one element of equity.

There are, however, at least three kinds of equalization: equalization of property wealth differences, equalization focused on student need and equalization of cost differences. Most of the new state school finance plans have concentrated on property wealth equalization. Many of them have also included pupil-weighted systems or expanded categorical programs to provide additional aid for varying pupil needs. Few states, however, have been able to consider ways to provide equalization for the differences in education costs among local school districts; no state has been able to develop cost of education indices among its local school districts.

The purpose of this booklet is to report on a project that the Education Commission of the States (ECS) recently conducted for the Missouri Governor's Conference on Education. The project, conducted as part of a total school finance and tax study, developed cost-of-education indices among all 565 school districts in the state of Missouri, based on 1974-75 data. The indices indicate the differences in the level of education services that a dollar can buy in one school district compared to what it can buy in another school district. The indices that were developed can be used in Missouri's state equalization aid formula to equalize the purchasing power of the education dollar among local school districts. The methodology that was developed in the Missouri study, moreover, can be used to develop cost-of-education indices in other states so that wealth, pupil-need and cost equalization can be accomplished through a state equalization aid formula.

The booklet is divided into five sections. The first discusses the differences between education costs and education expenditures and the alternative ways that education costs can be measured. The second section shows how economic analysis can be used to isolate and measure the factors that cause differences in education costs. Section III presents the economic framework that is used for the study. Section IV presents the results of the analysis that was used to construct the cost indices, discusses the cost indices that were developed and analyzes the effect of their use on the distribution of state equalization aid. The last section summarizes some of the issues raised by the study and suggests some policy implications of the results.

1. THE DIFFERENCE BETWEEN EDUCATION COSTS AND EDUCATION EXPENDITURES

Education **costs** refer to the prices, including the differences in prices, that school districts must pay for a specific level and quality of education services. Education **expenditures**, on the other hand, simply refer to what different school districts spend, irrespective of the level and quality of services bought with those expenditures. Although variations in the costs of education resources constitute one portion of the variation in education expenditures, variations in the level and quality of education services as well as variations in pupil need also contribute to expenditure variation.

As one example, consider two school districts that face exactly the same costs of education services. The two school districts must pay the same salary for a teacher with a given level of experience and education, and each school district has the same number of pupils. If school district A decides to have a pupil-teacher ratio of 15:1 and school district B decides to have a pupil-teacher ratio of 30:1, the expenditures in school district A will be twice what they are in school district B, assuming proportionate use of other resources. Although the two school districts will have different education expenditures, their education costs will be the same because they must pay the same price for each teacher. The expenditures are different because local decision makers in school district A decide to buy more teachers.

A cost-of-education study seeks to identify those elements outside of the control of school decision makers that create differences in the **costs** of education resources among local school districts. A cost-of-education index indicates whether it costs more or less for each school district, relative to the average school district, to purchase a given level of education quality. In this booklet the objective is to show how to determine and measure those elements outside the control of local education policy makers that contribute to differences in the purchasing power of the education dollar among local school districts. The example state is Missouri.

There are at least two basic ways to measure differences in education costs. The first is to measure differences in the cost of living and assume that these differences approximate the differences in costs of education. This method is, in fact, being used in Florida and was proposed for use in Oregon. The major problem with this method is that costs of living and costs of education are not the same. Thus, the use of a cost-of-living index, actually a consumer price index, includes numerous factors other than education costs and is not a very appropriate way to adjust for differences in only education costs.

The second way to adjust for differences in education costs is to use

what the economist calls the market price schedule. This schedule, determined statistically, deals directly with measures of price variation and the sources of those variations. This method has been used in the research reported in this booklet. The most common criticisms of the market price approach are that it usually ignores the effects of unions and collective bargaining, price variations caused by different pupil-need and pupil-size factors, and the constraints placed on declining enrollment districts by seniority and teacher tenure laws. The methodology used for the Missouri study to date has dealt intensively with all but the last problem. (See the appendix for a brief discussion and critique of other cost-of-education studies that have been conducted.)

II. ECONOMIC ANALYSIS AND COST-OF-EDUCATION INDICES

The analysis of the costs of education in this booklet is grounded in the discipline of economics. In particular, the analysis is based on actual descriptions of what school districts do as indicated by behavioral models that are part of economic theory. The goal of such models is to explain how decision-making units (for example, consumers, business firms or school districts) behave in allocating their resources. The models also can be used to examine changes in behavior in response to changes in the environment within which the decision-making units operate. For example, the models are designed to answer such questions as: How is the consumption of food or fuel affected by changes in the respective prices of food or fuel? How are expenditures on housing affected by changes in the personal income of consumers? How do business firms respond to changes in the wages that must be paid employees? How will education spending change when there are increases in state education aid? Economic models are used to predict the direction of the changes in behavior, such as whether more or less is spent, and, with the help of statistical techniques, to measure the magnitudes of the expected changes as well, such as how much more or less is spent.

The goal of economic models is to explain how decision-making units actually behave, **not** to reveal how they **should** behave. The models focus primary attention on the actual as opposed to the normative aspects of behavior.

What is meant by a model of behavior? The word "model" in this context takes on a similar meaning to its standard use. A model is a representation of reality. For example, a model train is intended to capture the basic characteristics of a real locomotive and, with the help of electrical power, to imitate its behavior. In general, models are not exact replicas since most of the characteristics of appearance and behavior of a locomotive can be conveyed without including every detail. An alternative way to model the behavior of a locomotive would be to write down ("specify") the mathematical relationships that describe its mechanical and technological capabilities. That is, one could specify a mathematical model that would describe the speed with which a locomotive could travel, given critical characteristics of the train, such as its weight, the capacity of its engine, the condition of the tracks and the weight of the cars that it is pulling.

In formulating an economic model, the economist begins with a set of assumptions about how organizations and individuals in those organizations behave in making decisions. The economist then proceeds, using logical deductions, to make predictions about how an organization will respond to certain kinds of changes in its environment, e.g., the re-

sponse of a school district to a change in state aid or a change in enrollment. The economist next develops a framework within which the changes in behavior can be analyzed. Just as in the case of a model train, the economic model of behavior can be expressed as a set of mathematical relationships that describe the choices school officials make (or the speed of a locomotive), given the environment of the district (or the weight, capacity, etc., of the locomotive). Moreover, the mathematical relationships provide a means for determining how behavior will change given changes in the factors that describe the environment, generally in numerical terms.

With appropriate statistical analysis, models can be used to describe the factors that influence the choices of education decision makers with regard to such things as the level of total education spending; the amount and mix of school inputs, e.g., teachers, administrators and supplies; characteristics of teachers and administrators such as educational preparation and experience; amount and quality of school buildings and various instructional materials; and the salaries paid to school personnel.

One might ask: Why bother to specify such a model? Of what real benefit is the formal economic process for analyzing behavior of school decision makers? The answer is that the model provides the economist with a framework within which to understand and analyze statistically the systematic patterns of costs and resource allocation. The model includes a variety of interrelationships among variables and aids the analyst in specifying the nature of the relationships between the decision or controllable variables (i.e., the level of education spending, the levels of employment of teachers and administrators, and the levels of compensation of school personnel) and all of the variables that define the uncontrollable environment within which the decision making occurs. For this study, a model is used to indicate the effect of various variables on education costs, to measure those effects and to use the results to calculate cost-of-education indices among school districts.

III. ECONOMIC FRAMEWORK FOR DEVELOPING COST-OF-EDUCATION INDICES

Differences in education expenditures across local school districts result from two factors: (1) variation in the amount (or "quality") of education services purchased and (2) variation in the cost of providing those education services. One of the primary differences between these two elements is that the amount of education services purchased by local school districts is a matter of choice within the control of school decision makers, given budget constraints. The cost of education services, however, is determined by factors outside the control of school decision makers.

Factors Causing Variations in the Amount of Education Services

The same basic elements that are used to determine the demand for various consumer goods and services influence the demand for education services as well. Variations across local school districts in the amount of education services purchased will in general depend on the price (or cost) of education services relative to the prices of all other consumer goods and services and the various financial and demographic characteristics that influence the willingness and ability of the local community to buy education services. For example, economic studies of school district spending patterns have revealed the following relationships, holding all else equal in each case: (1) commmunities facing higher relative costs of education services tend to purchase somewhat lower levels of services. (2) higher-income communities tend to purchase relatively higher levels of education services, (3) communities that receive larger amounts of state and/or federal aid tend to spend more on education services and (4) communities with large amounts of commercial compared to residential property (and, hence, impose a relatively larger portion of the initial tax burden on businesses as opposed to voting, tax-paying residents) tend to purchase larger amounts of education services.[1]

[1] For the reader who is not accustomed to thinking in terms of "holding all else equal," it is useful to explain what this phrase means. In each of the four cases above, a relationship between the amount of education services purchased and some other variable that has an influence on the level of services purchased is described. In each case the relationship that is specified is examined under the assumption that all of the other contributing factors are held constant. For example, the fact that studies have shown that "communities receiving larger amounts of state and/or federal aid tend to spend more on education services" does not mean that any district with more state aid spends more than any other district with lower state aid. What is meant is that if examination were made of two districts that were similar in every respect (i.e., they had the same relative cost of education services, the same levels of community income, the same relative amounts of residential versus

Decisions on the amount of education services are within the control of school policy makers. In constructing cost of education indices the amount of education services must be held equal across all school districts in order to measure differences in expenditures produced only by differences in costs or prices and not by differences in amount.

Factors Causing Variations in the Costs of Education Services

There are two sets of factors that cause variations in the cost of producing a given quality of education services: (1) those affecting the supply of school inputs and (2) those affecting the technology of education production.

Supply factors. Supply factors include those aspects of the environment that influence the supply, and hence the price, of school inputs. The salaries of education personnel (i.e., teachers, other instructional personnel and administrators) are by far the most important source of variation in the cost of education services attributed to supply factors.[2] Supply factors include those characteristics of school districts affecting the salaries that must be paid to recruit a given quality of school personnel.

There are two basic components of the supply factors: (1) the relative attractiveness of the district as a place to work and (2) conditions in the local labor market within which the district is located. Districts that are regarded for one reason or another as being relatively attractive places to work find it easier to attract teachers. In fact, the more attractive a school district, the lower the salary it has to pay to recruit a given quality of school personnel. Factors that affect a school district's relative attractiveness might include the size of the district (as measured by enrollment or average daily attendance [ADA]), the kind of city in which it is located (e.g., whether the district is in a central city enduring the usual problems of high crime rates, pollution, etc., that might make it a less attractive place to work or is located in a suburban or rural environment with the respective characteristics) and the racial and ethnic composition of the pupils in the district.

General labor market conditions surrounding the district also influence the cost of school personnel. Regions that exhibit high wages for other professional or white collar occupations or have a high cost of living tend to exhibit higher salaries for teachers, all else equal. Moreover,

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business property, etc.) except for the amount of state aid they received, it would be found that the district with the greater state aid would purchase more education services. In fact, because it is difficult, if not impossible to find two such districts, such comparisons cannot be made directly. Rather, formal statistical techniques, such as multiple regression analysis, must be used to analyze all of the factors that have an effect upon school spending, both simultaneously as they occur in actuality and independently as the relationships are described above.

[2] Other sources of variation in supply factors include variations in the prices of instructional materials, the costs of school construction and the salaries of maintenance personnel.

the existence of bargaining or strong unions may tend to boost wages in particular regions.

It is, in fact, the differentials in the salaries of school personnel attributed to the supply factors that are of concern in the determination of cost-of-education differentials based on teacher costs only, since these supply factors are outside the control of school decision makers. Differentials in the costs of all school resources, personnel and nonpersonnel, attributed to supply factors are the concern in the determination of cost differentials based on total costs.

Technology factors. A second set of factors that affect the cost of producing a given quality of education services are technological factors. In general technological factors affect the perceived physical relationships between educational outcomes and the school inputs used to produce the outcomes. There are two components of the technology factors: (1) pupil need and (2) the scale of district operations.

Conventional wisdom about education suggests that different kinds and combinations of school inputs are required to provide a given quality of education services to different kinds of pupils, e.g., handicapped or disadvantaged pupils. Specifically, the combination of school inputs used to provide a given level of education services usually varies systematically with the characteristics of the student population and with the scale of operation of the school district. For example, most school decision makers believe that it costs more and requires a different pattern of expenditure to provide a given quality of school services to handicapped pupils and to pupils from relatively disadvantaged families. The resultant difference in cost is caused by differences in pupil need.

Exclusive of the other effects of district size there are also differences in the costs of education in districts of different size because of economies and diseconomies of scale. For example, small school districts, through no fault of their own, may not be able to benefit from economies of large size such as specialization of labor or large-scale purchasing. On the other hand, very large school districts may incur extra costs (again due to factors beyond their control) because of diseconomies associated with large-scale operations such as reduced ability to monitor activities in larger numbers of schools and reduced ability to coordinate and organize various educational programs. At what size a district is not large enough or is too large is not a matter for speculation but a matter that can be determined statistically. To determine the most efficient size of a district requires examination of the relationships among expenditures, quality of services and district size.

Once again it must be emphasized that the variables that are included among the technology factors, the characteristics of pupils and the scale of district operations, are outside the control of local decision makers. The value of a dollar's worth of expenditure will tend to vary in the quality of education services it will buy due to the level of pupil need and the scale of district operations. However, the type of policy

options that the state may want to adopt for these differences in costs may be different. For example, state aid could be increased to help high pupil-need districts while school district consolidation or decentralization could be encouraged for school districts experiencing diseconomies of very small or very large size.

Other constraints on district choice. There are, in fact, two additional factors that may have an influence on the costs of education services. These factors involve the constraints (or limitations) on the choices made by school decision makers with respect to the employment of certain kinds of school inputs. These limitations on district choice include: (1) seniority provisions and tenure laws and (2) capital constraints.

School decision makers face constraints on the allocation of resources in local school districts imposed by tenure laws and seniority provisions. Seniority provisions, while allowing school districts to choose the number of teachers to be employed, restrict the choice of which teachers and, therefore, which combinations of teacher characteristics, including average experience or education can be employed. This restriction derives from the use of seniority as the basis for the order of dismissal of school personnel in response to a decline in enrollment or a cutback in the educational programs. Thus, school district decision makers are unable in the short run to influence greatly the composition of the teaching staff with respect to years of experience when enrollments decline. The average level of educational preparation and experience of the district's personnel can be adjusted only at the margin through newly hired staff members. For school districts experiencing declining enrollments, such adjustments are nearly impossible because few, if any, new personnel are hired.

The impact of this limitation can result in a school district having a teaching staff with more experience than it otherwise would choose. This limitation is especially critical for school districts experiencing declining enrollments. To the degree that a district has "excessive" experience in its staff (where excessive in this context means "excessive in the view of the local decision makers"), it will be paying higher salaries to teachers than it otherwise would choose. The extent of these higher salaries adds an increment to the costs of education that is outside the control of school decision makers.

A means for attacking this analytical problem is to use statistical analysis of the demand by local school districts for new teachers, particularly of the characteristics of these new teachers (e.g., experience and educational preparation), to determine the degree to which some districts possess "excessive" experience or educational preparation among their teaching staffs. From this information the higher cost of this limitation can be determined and added to the "costs of education" for the district.

A second limitation on district decision making involves the short-run inability of school decision makers to adjust the level of capital, that is, the sizes and number of school buildings in the district, to changes

in enrollment. The purchase or sale of school buildings is a time-consuming process involving considerable long-range planning. Thus, districts facing rapidly increasing or declining enrollments are likely to face higher costs of education in the short run due to their inability to adjust the number and sizes of their buildings to the desired level. This limitation on capital is short run in nature. Nevertheless, in dealing with the total picture of the costs of education the impact of these short-run phenomena should be identified correctly.

The foregoing discussion has been an outline of the components of an economic model that can be used to determine costs of education among school districts. It is a model in the sense that it describes the manner in which one would expect costs of education to respond to changes in a set of factors that make up the environment within which school decision making is carried out. Table 1 briefly outlines the components of the model and provides a shorthand reference to the kinds of variables that are used to represent the various elements in the model. It is the mathematical formulation of this model that forms the basis for the statistical analysis of cost.

Table 1

Factors Affecting the Costs of Education

1. **Supply Factors:** those factors affecting the supply and, hence, the prices of school inputs.
   a. **Relative attractiveness of the district:** represented by district size, characteristics of the city in which the district is located (central city, suburb, rural); racial, ethnic and socioeconomic background of the pupils.
   b. **Labor market conditions:** represented by identifying the region in which the district is located (i.e., whether or not it is a high wage or high cost-of-living region).
2. **Technology Factors:** those factors affecting the perceived physical relationships between educational outcomes and school inputs.
   a. **Pupil-need:** represented by the proportion of disadvantaged and/or handicapped pupils in the district.
   b. **Scale of operation:** represented by district size (i.e., the ability of the district to take advantage of certain economies or be subject to certain diseconomies of scale).
3. **Constraints on District Choice:** limitations on the ability of the district (in the short run) to select the desired levels of employment of certain school inputs.
   a. **Seniority provisions:** the inability of the district to adjust fully the average level of experience, etc., of its staff. Seniority provisions result in "excessively" high average salaries due to "excessive" (in the eyes of school decision makers) average levels of experience, etc., among the staff of the district.
   b. **Capital constraints:** the inability of the district (in the short run) to adjust the number and sizes of school buildings (as well as other kinds of capital equipment) to the appropriate level, given enrollment. This constraint is represented by measures of school district capacity and is designed to capture the impact on costs of rapidly declining or rising enrollments.

Assessing the Differences in Costs of Education Across School Districts

There are two stages to the process of assessing differences in the costs of education. The first stage involves the use of statistical techniques to determine the extent to which variations in the level of education expenditures across local school districts can be attributed to variations in the **quality** of education services, variations in the **supply** factors and variations in the **technology** factors.[3] The second stage is to use the results of the statistical analysis to answer the hypothetical question: What would be the variation in education expenditures across school districts if all districts were to provide the same level of education quality (services)? Clearly, by holding quality constant across all school districts, variations in expenditures would be caused entirely by differences in the supply or technology factors. That is, some districts would have to pay relatively higher salaries to teachers, holding teacher quality constant, because they are less attractive places to work or because they are located in a region with a high cost of living. Other districts would incur greater costs of education because they have relatively large numbers of disadvantaged or handicapped pupils living within their boundaries. **Variations in the supply and technology factors, both of which are outside the control of local school decision makers, are the cause of differences in the amount of services a dollar of education spending will purchase. It is the variation in supply and technology factors that are used to calculate cost-of-education indices across local school districts.**

One might ask at this point, "How is quality measured?" Ideally, one would like to have some universally accepted concept of education quality that would allow for comparisons of the level of education services across school districts. However, there are significant obstacles to establishing such a concept of quality. Despite the difficulties in assessing and measuring the quality of education services, it is evident that everyone makes assessments on the quality of the educational process. In many cases these judgments are based only upon perceptions of how the educational process operates and, in particular, how the various inputs into the process affect the desired outcomes.

One useful and simple way of assessing the quality of education services is to measure the inputs employed by local school districts to provide education. This approach defers the measurement of education quality to local school decision makers' judgments as revealed through the levels of employment of school inputs across local school districts. The employment levels of school inputs are regarded in this context as measures of the quality of education services provided.

For the purposes of the study of Missouri school districts, there were

[3] In addition it would be necessary to determine the impact of the limitation of current district capacity (capital constraints) and seniority on variations in education expenditures. However, for the purpose of simplifying this discussion, these constraints (limitations) are not dealt with explicitly here.

two alternative measures of education service levels readily available. The first was a direct measurement of the level of employment of various school inputs, e.g., numbers of teachers and administrators and the educational preparation of teachers. The second was an indirect measurement of school inputs, the programmatic classification scheme of the state. Since the assignment of a particular classification is based largely on the level of various school inputs employed and offerings produced, districts with higher classifications ("AAA" districts as opposed to "A" districts) are assumed to be providing greater levels of education services. The results in this booklet are based on the latter quality measure; the former measure is much more difficult to use but is the subject of continuing ECS research on cost-of-education indices.

Although difficult to develop, some definition of education quality must be selected because quality must be controlled across school districts in order to determine both differences in the cost of education services as well as additional costs associated with educating the economically disadvantaged or handicapped student. Controlling for quality on the input rather than the output side, while not perfect, is at least possible and the following results are based on such a quality control.

IV. COST-OF-EDUCATION DIFFERENTIALS IN MISSOURI

Using the economic framework outlined in the previous section, relevant data on school districts and teachers in the state of Missouri were gathered in order to analyze the factors that were hypothesized to cause variations in salaries paid to teachers and total expenditures per pupil. The statistical technique used to analyze the data was multivariate regression. The regression technique long has been accepted and used as a standard approach in analysis of data in social science research by economists, sociologists, political scientists, psychologists and management scientists.

Regression analysis is used to determine and evaluate the nature of behavioral relationships among sets of variables. In particular it is used to estimate the impact of the variations in independent variables (e.g., district size or measures of pupil need) on the variation in some dependent variable (e.g., teachers' salaries or education expenditures). For example, estimates can be derived that indicate the impact of the variation in the degree of pupil need in a district on the level of education expenditures per pupil, holding other factors constant.

The purpose of this analysis is to use the estimates derived from the regression technique to calculate the impact of variation of the supply and technology factors, such as the variables outside the control of local school districts, on education expenditures and teachers' salaries. From the estimates of the variation in education expenditures and teachers' salaries due to variations in these cost factors an index of the relative variation in the costs of education across local school districts in the state of Missouri can be calculated. The cost index indicates the extent to which variation in education expenditures and teachers' salaries can be attributed to differences in the costs of services as opposed to differences in the amount and quality of school services local decision makers decide to buy. Two types of cost indices were developed for Missouri: one based only on costs of teachers and one based on the costs of all education inputs.

An Example of How a Cost Index is Calculated

Suppose that statistical analysis (the regression analysis) indicated that teachers' salaries were a function of the size of the school district (a supply factor) and the number of graduate hours of education of the teacher (a quality factor). Specifically, suppose that the "mathematical model" for predicting the average salary in each school district was found to be:

> Average salary = \$9000 + (\$40 per graduate hour x number of graduate hours) + (\$1 per pupil x number of pupils in district)

Of course, a complete model of the determinants of teachers' salaries would include many more factors as discussed below. For the purpose of this example, it is assumed that there are no factors other than graduate hours and district size in order to simplify the explanation.

The numbers 9000, 40 and 1 would be estimated by the regression technique. In other words, the equation says that the salary of a teacher is equal to $9000 plus $40 times the number of graduate hours attained by the teacher plus $1 times the district size (ADA). Alternatively stated, the market for teachers dictates that a teacher's salary will increase by about $40 for each graduate hour, holding district size constant. For each additional pupil in the district, school officials find that they must pay a salary $1 higher in order to attract teachers with a given number of graduate hours.[4]

In calculating a cost index, it is important to recognize the distinction between what the variables "graduate hours" and "pupil size" represent. The variable "graduate hours" is a decision or a choice variable for the district. It is regarded as a measure of teacher quality and, more importantly, is a variable that can be influenced by school decision makers in terms of the ability of school officials to hire teachers with more or less graduate hours. On the other hand, the variable "pupil size" is outside the control of local decision makers and is therefore regarded as a component of cost.

Now, take two hypothetical school districts, A and B. Assume that the pupil size of school district A is 1000 and that the average number of graduate hours of its teachers is 30. Assume that the number of pupils in school district B is 2000 and that the average number of graduate hours of its teachers is 20. Measured by graduate hours, therefore, school district A has the higher-quality staff.

If the equation predicts accurately the actual teacher salary in each school, the salary in district A would be:

$$\begin{aligned} \text{Average salary in A} &= \$9000 + (\$40 \times 30) + (\$1 \times 1000) \\ &= \$9000 + \$1200 + \$1000 = \$11{,}200 \end{aligned}$$

The actual salary in school district B would be:

$$\begin{aligned} \text{Average salary in B} &= \$9000 + (\$40 \times 20) + (\$1 \times 2000) \\ &= \$9000 + \$800 + \$2000 = \$11{,}800 \end{aligned}$$

In constructing a cost index neither of these actual salaries would be

[4] Note that this is a hypothetical example and that the relationship between district size and teachers' salaries is likely to be more complicated. For example, it is likely that the effect on salaries of increasing district size by 1000 pupils will differ depending on the initial size of the district. There is likely to be a greater difference in salary if size were to increase from 500 to 1500 pupils than if size were to increase from 20,000 to 21,000 pupils. However, in the simple example described, such subtleties in the relationship are ignored.

used because quality must be standardized in calculating a cost index. The state average teacher salary and the state average number of graduate hours can be used to compute the index. Suppose these numbers were $11,500 and 25, respectively. Then the calculated salary in each school district — controlling for quality — would be:

Average Salary in A =	$9000	+ ($40 x 25)	+ ($1 x 1000)	
	= $9000	+ $1000	+ $1000	= $11,000
Average Salary in B =	$9000	+ ($40 x 25)	+ ($1 x 2000)	
	= $9000	+ $1000	+ $2000	= $12,000

The teacher-cost index for school district A would be the calculated salary divided by the statewide average salary: $11,000/$11,500 = 0.96. Likewise the teacher cost index for school district B would be $12,000/$11,500 = 1.043. These index values indicate the relative salaries that districts A and B would have to pay if they both had hired teachers with 25 graduate hours.

Notice that the actual pupil size was used in the determination of the calculated salary. This is because size is a supply factor, outside the control of school decision makers, and the variable that determines the cost index. However, the teacher-quality variable used was the statewide average since this is under the school decision makers' control and must in effect be held constant for all school districts.

Cost-of-Education Indices in Missouri

In the following analysis, numerous quality and supply factors have been identified. In calculating the cost indices, the quality factors have been controlled by using statewide averages rather than school district figures. School district figures, though, have been used for the supply factors. The differences among Missouri's school districts in the supply factors produce the variation in the cost indices.

Two types of cost indices were constructed, one based on the determinants of teachers' salaries and one based on the determinants of expenditures per pupil.

Determinants of teachers' salaries. In order to explain the salaries of school personnel among school districts, it is necessary to introduce the concept of a **market price schedule.** Labor market transactions involve a mutual exchange of labor's productive attributes and the attributes of the work place that define working conditions. In the market for teachers, teachers sell the services of their labor, but simultaneously purchase the characteristics of the schools in which they work.[5] On the other side of the bargain, school administrators purchase the desired characteristics of teachers and jointly sell to teachers the characteristics of schools and students. Each teacher's con-

[5] This discussion relies heavily on a paper by Joseph Antos and Sherwin Rosen, "Discrimination in the Market for Public School Teachers" (Washington: U.S. Department of Labor, September 1974).

tract specifies a price (salary) for the total package of labor services and on-the-job consumption (i.e., working conditions); the content of the package varies from district to district (and even from school to school). Hence, salary comparisons across teachers and districts (i.e., across the desired characteristics of teachers and the working conditions in school districts) reveal a relationship from which it is sometimes possible to impute prices for various dimensions of the underlying package of teacher and district characteristics. This observed relationship between salaries, teacher characteristics and school district characteristics is determined by the market and is referred to as the market price schedule for teachers. While neither teachers nor administrators are totally aware of all dimensions of these employment decisions, statistical analysis can be used to give specific values to most of the elements that are included in this implicit market process.

There are a number of variables that are included in the determination of teachers' salaries according to the concept of the market price schedule. The variables can be divided into two categories: (1) the endogenous variables within the control of local school decision makers such as quality factors and (2) the exogenous variables outside the control of local school decision makers, such as supply factors. Table 2 lists the quality and supply factors that were analyzed as the determinants of teachers' salaries.

Table 3 gives the results of the analysis and lists the important variables that determine the variation in salaries of teachers among Missouri schools.[6] In some instances direct measures of variables described in Table 2 could not be obtained and proxies in these cases were utilized. For example, rows 17 and 18, expenditures per ADA and median family income, are included to reflect the fact that wealthier districts — those with greater budgets or higher-income families — pay higher teacher salaries as a way of recruiting higher-quality teachers. The variables in rows 1 to 25 are the quality variables; in determining a cost index for each school district, the statewide averages of these variables were used. The variables in rows 26 to 58 are the supply variables, those factors outside the control of local school decision makers that are the determinants of cost differentials among school districts. The numbers in column 2 of the table correspond to the numbers $40 and $1 in the equation in the above illustration and are the estimated coefficients determined by the regression analysis statistical procedure that was used.

Column 3 indicates the percentage effect on teachers' salaries of a one-unit change in any of the variables listed in column 1. Column 4 indicates the dollar equivalent of the percentage effect in column 3. For example, teachers with a master's degree (row 7) receive a salary that is 10.68 percent or $1012 above that of a teacher with only a B.A. Similarly, for every year of teaching experience (row 10) teachers earn an extra 1.25 percent or $119 in additional salary. Thus, a teacher with 10 years of teaching experience earns an additional 12.5 percent or an extra $1190 per year.

[6] Most, but not all, of the listed variables were "statistically significant."

Table 2

Controllable and Uncontrollable Variables Affecting Salaries of Teachers

1. **Controllable Variables:**
   a. **Educational preparation:** measured by hours of graduate study and college degree attained by the teacher.
   b. **Professional experience:** measured by total years of experience and years of experience in the present district.
   c. **Level of instruction:** whether the teacher is an elementary, junior high or high school teacher.
   d. **Working conditions:** measured by average class size (or teacher-pupil ratios) and the availability of instructional supplies and materials.
   e. **Staff turnover:** reflection of the stability of the teaching staff and measured by the proportion of new teachers hired in the district.
   f. **Other teacher quality characteristics:** measured by the state's classification scheme and the size of the per pupil budget of the district. All of these variables are proxies for other teacher characteristics based on the notion that better quality districts or higher budget districts tend to hire "better" quality teachers (e.g., teachers with greater verbal proficiency, greater intelligence or other perceived ability characteristics).
2. **Uncontrollable Variables:**
   a. **District location:** reflected by the location of the district within the state.
   b. **Community characteristics:** measured by the nature of the city within which the district is located, e.g., whether it is located in a central city, suburban or rural area and whether it is a high or low density district. Separate variables are included to identify the unique factors associated with the St. Louis and Kansas City school districts, which are located in the largest metropolitan areas in the state of Missouri.
   c. **District size:** measured by average daily attendance and intended to reflect the diversity of community attitudes with which school personnel may come into contact, the bureaucracy of the district and other similar correlates of organization size.
   d. **Pupil characteristics:** measured by the racial, ethnic and socioeconomic composition of the pupils.
   e. **District structure:** whether the district is an elementary or unified district and the proportion of pupils enrolled in elementary vs. upper grades.
   f. **Disequilibrium:** measured by the growth of the district, which reflects the increased or decreased need for teachers in the district.
   g. **Collective bargaining:** measured by the existence of formal or informal negotiations between teachers and school boards.

Row 17 shows that a one-percent increase in expenditures per pupil produces only a 0.21-percent increase in teachers' salaries. This result implies that about 13 cents of a $1 increase in the per pupil budget will be used to raise teacher salaries. The remaining 87 cents will be used, for example, to increase staff-pupil ratios or for other instructional inputs. This result indicates quite strongly that higher expenditures are not used simply to increase the teacher salary schedule. This result is consistent with studies in other states that indicate that the largest proportion of increases in expenditures per pupil are used to expand the educational program or hire more teachers rather than to increase salaries.[7]

Row 19 indicates that high school teachers earn 1.41 percent or $134 more than elementary teachers. The negative signs for the variables in rows 21, 22 and 23 mean that higher teacher salaries are paid in school districts with lower teacher turnover rates and probably higher class size. Row 24 shows that male teachers earn 4.18 percent or $396 more than female teachers, holding all else constant.

The geographical locations of the 14 regions in rows 26 to 39 are indicated on Map 1. These regions were determined on the basis of population density, labor market conditions, geography and other factors that define a socially and economically cohesive geographical area. The results show that teachers in the northeast, region 3, earn 6.88 percent or $653 less than teachers in the southeast, region 14, used here implicitly as a base. On the other hand, teachers' salaries were 6.56 percent higher in the St. Louis metropolitan area but only 1.82 percent higher in the Kansas City area.

Rows 40 to 46 indicate that, except for the very largest school districts, teacher salaries increase as the number of pupils in the school district increases. This result is consistent with the assumption that teachers prefer to work in smaller school districts and must be paid more to work in larger districts.

The information in rows 47 to 54 indicate the effect on teachers' salaries of central city (five in Missouri), suburban (divided into fast or slow growth) or rural location. Salaries in St. Louis were 24.07 percent or $2281 higher than those in rural areas, for example. Salaries in slow-growth suburbs, those suburbs closest to central cities, were only $468 higher than those in rural areas.

Row 55 indicates that teacher salaries increase by $2.82 for every one-percent increase in the percent of minority pupils in a school district. In other words, a school district that is 50 percent minority pays its teachers an additional $142 compared with a school district that has no

[7] See Allan Odden, "How Do Schools Spend 'New' Money?" *Compact*, Vol. 10, No. 4, Fall 1976. See also Stephen M. Barro and Stephen J. Carroll, *Budget Allocation by School Districts: An Analysis of Spending for Teachers and Other Resources* (Santa Monica, Calif.: The Rand Corporation, Dec. 1975), and Jay G. Chambers, "An Analysis of Resource Allocation in Public School Districts," unpublished manuscript, Univ. of Rochester, November 1976.

Table 3

Determinants of Teachers' Salaries Among Missouri School Districts*

(1) Explanatory Variables	(2) Estimated Coefficient	(3) Percentage Effect on Teachers' Salaries**	(4) Absolute Effect on Teachers' Salaries
I. Controllable variables			
(1) Education: No BA Degree	0.04907	5.03	$ 476.62
(2) Education: BA Degree	--	--	--
(3) Education: 15-29 Graduate Hours	0.03229	3.28	311.00
(4) Education: 30-44 Graduate Hours	0.03711	3.78	358.29
(5) Education: 45-59 Graduate Hours	0.05460	5.61	531.82
(6) Education: 60 or more Graduate Hours	0.10791	11.39	1,079.85
(7) Education: MA Degree	0.10150	10.68	1,012.40
(8) Education: Special Education Certificate	0.11702	12.41	1,176.46
(9) Education: Doctorate Degree	0.12268	13.05	1,236.93
(10) Experience: Total Years	0.01246	1.25	118.82
(11) Experience: Total Years if More Than 20	-0.00693	-0.69	-65.45
(12) Experience This District: Total Years	0.01263	1.27	120.45
(13) Experience This District: Total Years if 10-19	-0.00304	-0.30	-28.77
(14) Experience This District: Total Years if More Than 20	-0.00664	-0.66	-62.72
(15) Experience More Than 40 Years: Yes	-0.13986	-13.05	-1,236.90
(16) Experience More Than 40 Years: No	--	--	--
(17) Log_e Expenditure/ADA	0.20697	0.21	19.61
(18) Median Family Income	0.0000057	0.00057	0.054
(19) High School Teacher: Yes	0.01400	1.41	133.61
(20) High School Teacher: No	--	--	--
(21) Turnover Rate: Elementary Teachers	-0.12304	-0.12	-11.65
(22) Turnover Rate: Upper-Grade Teachers	-0.05314	-0.05	-5.03
(23) Teacher-Pupil Ratio	-1.82890	-0.57	-53.58
(24) Sex: Male	0.04096	4.18	396.23
(25) Sex: Female	--	--	--
II. Uncontrollable Variables			
(26) Region 1	0.0	0.0	0.0
(27) Region 2	0.0	0.0	0.0
(28) Region 3	-0.07136	-6.88	-652.69
(29) Region 4	-0.04906	-4.79	-453.71

	(1)	(2)	(3)	(4)
(30)	Region 5	0.01801	1.82	$ 172.22
(31)	Region 6	−0.02018	−2.00	−189.32
(32)	Region 7	−0.02251	−2.23	−210.94
(33)	Region 8	0.06356	6.5%	621.89
(34)	Region 9	0.0	0.0	0.0
(35)	Region 10	0.0	0.0	0.0
(36)	Region 11	−0.02784	−2.75	−260.19
(37)	Region 12	−0.05701	−5.54	−525.16
(38)	Region 13	−0.05249	−5.11	−484.60
(39)	Region 14	--	--	--
(40)	District Size: Less Than 200 ADA	--	--	--
(41)	District Size: 200-499 ADA	0.03425	3.48	330.20
(42)	District Size: 500-999 ADA	0.07411	7.69	729.00
(43)	District Size: 1,000-4,499 ADA	0.12895	13.76	1,304.31
(44)	District Size: 4,500-7,499 ADA	0.16214	17.60	1,668.14
(45)	District Size: 7,500-19,999 ADA	0.17154	18.71	1,773.39
(46)	District Size: 20,000-30,000 ADA	0.14689	15.82	1,499.47
(47)	Columbia	0.0	0.0	0.0
(48)	Springfield	0.13327	14.26	1,350.99
(49)	Kansas City	0.15652	16.94	1,605.68
(50)	St. Joseph	0.0	0.0	0.0
(51)	St. Louis	0.21569	24.07	2,281.21
(52)	Suburb Fast Growth	0.03358	3.42	323.63
(53)	Suburb Slow Growth	0.04818	4.94	467.71
(54)	Rural	--	--	--
(55)	Percent of Minority Pupils	0.02929	0.0293	2.83
(56)	Percent of Elementary Pupils	0.10722	0.11	10.17
(57)	Elementary District: Yes	−0.09428	−9.00	−852.64
(58)	Elementary District: No	--	--	--

Note: The results are based on a sample of 4202 teachers. The R^2 for this regression is 0.85 and the F statistic is 544 with (44, 4157) degrees of freedom.

* A log-linear form of this teachers' salary equation was used to estimate the coefficients in column (2).

** The figures presented in column (3) represent the percentage effect on teachers' salaries of a one-unit change in each of the explanatory variables listed in column (1). For the dichotomous ("either-or") variables, a one-unit change refers to whether the variable takes on the value one or zero. Dichotomous variables are used to measure educational preparation, type of teacher (i.e., elementary or high school), sex of teacher, type of district (i.e., elementary or unified), location of the district, and district size. A one-unit change in the variables measured as proportions (i.e., turnover rates, proportion minority pupils, and proportion elementary pupils) is equal to 0.01, which equals one percentage point. A one-unit change in education expenditures per ADA is equal to one percent since this explanatory variable enters the equation as its natural logarithm. For median family income, a one-unit change is equal to $1. Finally, a one-unit change in the teacher-pupil ratio is equal to that change corresponding to a change of one pupil in the pupil-teacher ratio (e.g., an increase of one pupil per classroom).

Source: Allen Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research for the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), pp. 244-5.

Map 1

Geographical Regions of Missouri

Source: Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), p. 246.

minority students. Rows 57 and 58 document the lower salaries in elementary school districts.

The cost indices based on these results were calculated by holding constant all the quality variables (rows 1 to 25) and using district values only for the supply variables (rows 26 to 58). A discussion of the indices is given in the last part of this section.

Determinants of education expenditures. Table 4 gives the results for the variables that were used to determine the variations in expenditures per pupil among school districts in Missouri. The variables in rows 1 to 7 are the variables within the control of school decision makers and those variables held constant in calculating the cost indices. The variables in rows 8 to 38 are the supply and technology factors that are outside the control of school decision makers and the variables that affect the magnitude of the cost indices. Again, the numbers in column 2 correspond to the numbers \$40 and \$1 in the equation in the earlier illustration and are the estimated coefficients determined by the regression analysis statistical procedure that was used.

As noted earlier, quality is controlled on the input side by using the state programmatic classification scheme. The data indicate that class AAA districts (row 1) spend 30.75 percent (\$306.18) more per student as compared to unclassified school districts. Row 5 shows that for class AAA districts, expenditures per pupil decrease by 1.14 percent for every one-percent increase in the percent of handicapped students in the district. The latter result reflects the notion that a given quantity of school inputs (here as represented by a classification index) has less value in producing education services for the handicapped, i.e., it takes more inputs to educate the handicapped.

The results in row 8 indicate that for every one-percent increase in the percent of handicapped in a school district, school districts spend an additional 1.26 percent more or an additional \$12.55 per ADA. These data also were used to calculate pupil weightings for handicapped students. Those weightings are given in Table 5. The implied pupil weightings, based on various concentrations of handicapped students, range between approximately 2.26 and 2.74. In other words, the results indicate that for a school district with 10 percent of its students needing special education services, a weighting of 2.33 for those students would approximate the extra cost that school districts are now expending on those students. If Missouri were to change the current method of allocating state aid for special education (flat grant dollar amounts per classroom unit), the weights in Table 5 might be used to construct a pupil weighting method of reimbursement upon further refinement of the analysis. A discussion of cost indices based just on pupil need is given below.

Rows 9 to 22 show the effect of geographical location on expenditures per pupil. The last major result in Table 4 is information on economies of scale as indicated in rows 25 to 35. The highest costs per pupil occur in school districts with fewer than 100 ADA. Costs per pupil then

Table 4

Determinants of Education Expenditures Per Pupil Among Missouri School Districts

Explanatory Variable	(1) Estimated Coefficient	(2) Percentage Effect On Education Costs/ADA	(3) Absolute Effect On Education Costs/ADA
I. Controllable Variables			
(1) Class AAA	0.26812	30.75%	$ 306.18
(2) Class AA	0.16567	18.02	179.41
(3) Class A	0.13509	14.46	142.02
(4) Unclassified	---	---	---
(5) Percent of Handicapped if AAA District	−1.14324	−1.14	−11.32
(6) Percent of Handicapped if AA District	−1.05641	−1.05	−10.46
(7) Percent of Handicapped if A District	−1.11485	−1.11	−11.04
II. Uncontrollable Variables			
(8) Percent of Handicapped	1.25230	1.26	12.55
(9) Region 1	0.06678	6.91	68.76
(10) Region 2	0.09048	9.47	94.29
(11) Region 3	0.06253	6.45	64.25
(12) Region 4	0.0	0.0	0.0
(13) Region 5	0.0	0.0	0.0
(14) Region 6	0.0	0.0	0.0
(15) Region 7	0.0	0.0	0.0
(16) Region 8	0.0	0.0	0.0
(17) Region 9	0.0	0.0	0.0
(18) Region 10	−0.10506	−9.97	−99.30
(19) Region 11	0.0	0.0	0.0
(20) Region 12	−0.05692	−5.53	−55.09
(21) Region 13	−0.05338	−5.20	−51.76
(22) Region 14	---	---	---
(23) Percent of Minority Pupils	0.20010	0.20	1.99
(24) Percent of Elementary Pupils	−0.18063	−0.18	1.80
Low-Density Districts			
(25) District Size: Less than 100 ADA	---	---	---
(26) District Size: 100-199 ADA	−0.15381	−14.26	−141.99
(27) District Size: 200-399 ADA	−0.22024	−19.77	−196.85
(28) District Size: 400-599 ADA	−0.23015	−20.56	−204.72
(29) District Size: 600-999 ADA	−0.23543	−20.98	−208.90
(30) District Size: 1000-1999 ADA	−0.30322	−26.16	−260.46
(31) District Size: 2000-2499 ADA	−0.33023	−28.12	−279.99
(32) District Size: 2500-2999 ADA	−0.21259	−19.15	−190.68
(33) District Size: 3000-3999 ADA	−0.20168	−18.26	−181.81
(34) District Size: 4000-7999 ADA	−0.13973	−13.04	−129.84

(1)	(2)	(3)	(4)
II. Uncontrollable Variables (Cont.)	Estimated Coefficient	Percentage Effect on Teachers' Salaries**	Absolute Effect on Teachers' Salaries
(35) District Size: More than 8000 ADA	−0.05949	−5.78	−57.55
High-Density Districts			
(36) High-Density Districts	0.23472	26.46	263.42
(37) High-Density Districts With 12,000-30,000 ADA	−0.21015	−18.95	−188.72
(38) Log_e Pupil Density	−0.05598	−0.056	−0.56

Note: The R^2 for this regression is 0.42 and the F statistic is 14 with (28,536) degrees of freedom. Although the R^2 is only 0.42, the results for the variables listed are strong and it is felt that the equation captures the bulk of expenditure variation caused by the uncontrollable factors.

Source: Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), p. 248.

Table 5

Costs of Educating the Handicapped*

Percent Handicapped	Percent Increase in Total Education Costs Per Pupil	Implied Pupil Weighting
1	1.26	2.26
5	6.46	2.29
10	13.34	2.33
20	28.46	2.42
50	87.04	2.74

* The mean percent of handicapped pupils in Missouri school districts is 9.16 percent.

Source: Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), p. 249.

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decrease as size increases until the apparently financially optimal size of 2000-2499 students is reached. School districts in this range of ADA experience 28.12 percent lower costs per pupil as compared to school districts with an ADA less than 100. School districts with an ADA larger than 2500 experience higher costs per pupil than school districts with an ADA between 2000 and 2499 but still have lower costs than school districts with an ADA less than 100. The results in rows 25 to 35 hold only for school size less than 12,000 ADA. School districts with very large ADA experience substantial diseconomies of large scale, as will be indicated by the cost indices based just on the size factor discussed below. The cost index based on the uncontrollable factors of Table 4, exclusive of the pupil need and size component, are also discussed below.

Discussion of Cost Indices Among Missouri School Districts

On the basis of the results for the teacher salary equations in Table 3, two cost indices were developed: a district-by-district index and a regional index. From the results for education expenditures per pupil in Table 4, three cost indices were calculated: one reflecting pupil need, one reflecting the effect of size (economies or diseconomies of scale) and one reflecting all of the other supply variables.

The mean, minimum, maximum and standard deviation of the cost indices calculated are given in Table 6. These statistics show that the cost indices vary within a reasonable range. For example, on a school district basis, teacher costs for a given level of quality of teacher vary from 90.2 percent of the average to 116.7 percent of the average. That is, some school districts need to pay only 90.2 percent of the statewide average salary for the average quality teacher whereas some school

Table 6

Descriptive Statistics for Missouri Cost Indices

Type of Cost Index	Mean	Standard Deviation	Minimum	Maximum
Based on Teacher Costs				
District Index	1.003	0.057	0.902	1.167
Regional Index	1.000	0.023	0.962	1.047
Based on All Costs				
Supply Component	1.001	0.052	0.899	1.215
Pupil-Need Component	1.006	0.114	0.892	1.814
Size Component	1.004	0.096	0.809	1.421

Source: Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), p. 251.

districts must pay 116.7 percent of the statewide average. The regional index varies by a smaller amount, from a low of 96.2 percent to a high of 104.7 percent.

Total costs of education per pupil vary by a similar margin from a low of 89.9 percent of the statewide average, based on supply factors exclusive of pupil need and size, to a high of 121.5 percent. A widely varying component of differential costs is that due to school district size for which the costs vary from 80.9 percent to 142.1 percent of the statewide average. These results indicate that, based just on economic factors, there may be a need for further school district consolidation for the very small school districts and that there may be a need to decentralize the large school districts, especially the very largest school districts in the state.

Table 7 presents actual cost indices for a small sample of school districts in Missouri. The sample constitutes a variety of different kinds of school districts as measured by property wealth, expenditures, size and geographical location. The district index based on teacher costs (column 1) and the supply component index based on total costs (column 2) are above one for all the central cities listed except for the latter index for Springfield. These indices are also, in general, above one for the suburban districts in the table. The values of the indices for the rural districts vary but many are below one. In fact, the average of the indices for the metropolitan school districts (both central cities and suburbs) is 1.08 while it is 0.99 in the nonmetropolitan, rural districts. These results indicate that education costs are higher in urban-metropolitan areas than in rural areas.

The pupil-need index (column 4) could be used instead of a pupil-weighted formula if the state wanted to use a pupil-need cost index as the mechanism for distributing state aid for special education. Alternatively, the state could use the pupil weights presented in Table 5.

The indices in column 5 of Table 7 indicate whether school districts have higher costs (diseconomies) or lower costs (economies) due to pupil size. The indices show that costs are higher by 18 percent in St. Louis and 23.29 percent in Kansas City because of very large size.[8] Rather than compensate for such diseconomies by incorporating the size factor in a cost index that is used in allocating state aid, the state might recommend decentralization as noted above.

The Impact of Cost Indices on State Aid Allocations

Computer simulations of the impact of cost-of-education indices on state aid allocations were run. The basic school finance program used in the simulations was a foundation program with a guaranteed tax base

[8] Density effects have been included with size effects here. Since greater density tends to reduce costs, the indicated St. Louis size effect is smaller than for Kansas City even though the latter district is smaller.

Table 7

Cost-of-Education Indices for Selected Missouri School Districts, 1974-75

School District	(1) Cost Index Based on Costs of Teachers Only: District Index	(2) Cost Index Based on Costs of Teachers Only: Regional Index	(3) Cost Index Based on Total Costs: Supply Component	(4) Cost Index Based on Total Costs: Pupil-Need (Handicapped) Component	(5) Cost Index Based on Total Costs: Size Component
Central City:					
Columbia	1.0628	0.9917	1.0242	0.9993	1.0329
Kansas City 33	1.0891	1.0170	1.1314	1.0767	1.2329
St. Louis City	1.1674	1.0468	1.1501	1.0299	1.1800
Springfield RXII	1.1126	0.9708	0.9497	1.0031	0.8375
Suburb:					
Ash Grove RIV	1.0043	0.9708	0.9437	0.9869	1.0694
Brentwood	1.1307	1.0468	1.0298	0.9855	1.1568
Independence	1.1121	1.0170	1.0051	0.9945	0.9718
Ladue	1.1327	1.0468	0.9990	0.9769	1.0315
Mehlville RIX	1.1572	1.0468	0.9990	0.9714	0.9896
North Kans. City 74	1.1231	1.0170	1.0028	0.9922	0.8259
Raytown C2	1.1083	1.0170	1.0048	1.0012	1.0073
Sturgeon RV	0.9905	0.9917	0.9990	0.9200	1.0092
Rural:					
Butler RV	1.0449	1.0056	0.9990	0.9943	0.9151
Canton RV	0.9783	0.9756	0.9990	0.9051	0.9967
Carrollton RVII	1.0449	1.0056	1.0936	1.0181	0.8765
Clever RV	0.9542	0.9708	0.9437	0.9409	0.9989
Cole Camp RI	0.9956	0.9931	0.9990	1.0756	0.0355
Crawford Cty. RII	1.0463	1.0056	0.8993	0.9890	0.9120
Eminence RI	0.9547	0.9735	0.9470	1.1034	1.0680
Fairfax RIII	0.9847	1.0056	1.0680	0.9716	1.0576
Gilman City RIV	0.9809	1.0056	1.0936	0.8916	1.0875
Greenville RII	1.0113	1.0056	0.9990	1.0224	1.0470
Hayti RII	1.0490	1.0056	1.1319	1.1703	0.8554
Joplin RVIII	1.0553	0.9884	1.9990	0.9798	1.0465
Norwood RI	0.9527	0.9708	0.9437	0.9295	1.0422
Pike RII	0.9919	0.9756	1.0220	0.9226	0.9705
Schuyler County RI	0.9658	0.9624	1.0634	1.0618	1.0254
Wheaton RIII	0.9753	0.9884	0.9990	0.9278	0.9470

Source: Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), Appendix H.

Table 8

Simulated Impact of Using a Cost-of-Education Index in Allocating State Aid in Missouri

(1)	(2)	(3)	(4)	(5)	(6)
			Simulated Revenues (Total Expenditures) Per Pupil		
Simulated Program	Cost Index Applied to:	Change in State Aid (millions)	Central Cities	Suburban Districts	Rural Districts
Foundation and Guaranteed Tax Base (GTB)	none	--	$1370	$1267	$1056
Foundation and Guaranteed Tax Base (GTB)	State Aid	$11	$1409	$1269	$1052
Foundation and Guaranteed Tax Base (GTB)	Foundation and GTB	$24	$1447	$1274	$1056

Source: Developed from the simulated school finance program in Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976).

(GTB) above the foundation expenditure.[9] The cost index used was the supply component index, exclusive of pupil-need and size factors.

Three simulations were run: the basic program with no cost index, a run for which the cost index was applied only to the state aid payments and a run for which the cost index was applied to both the foundation expenditure and the GTB. Whichever way the cost index is used, it increases state aid for school districts with an index above 1.0 and decreases aid for districts with an index below 1.0. The results are given in Table 8.

Three aspects of Table 8 are of major importance. First, the use of cost-of-education indices costs money, whether the index is applied only to the state aid or to the foundation expenditure and GTB. The reason that the use of cost indices increases the cost to the state is that the cost indices are, in general, above one in the more populous, metropolitan areas. Thus, even though the average cost index among all school districts is close to 1.0, the higher indices occur in the larger school districts and the lower indices occur in the smaller school districts.

[9] For the particular Missouri school finance simulation utilized, see Allan Odden and Phillip E. Vincent, *Analysis of the School Finance and Tax Structure of Missouri: Background Research of the Educational Finance Committee of the Governor's Conference on Education* (Denver, Colo.: The Education Commission of the States, 1976), Chapter 2 and Appendix C.

Another result in Table 8 is that the extra cost is less when the index is applied only to state aid than when it is applied to total expenditures (the foundation expenditure and the GTB). Since cost indices reflect the differentials of costs of education for all school services, full equalization of cost differences is accomplished by applying the index to total expenditures, not just state aid. However, in view of state budget constraints or state politics, the use of a cost index on only the state aid is at least a first step in equalizing cost-of-education differences caused by factors outside the control of school decision makers.

The last aspect of Table 8 is the effect of the cost index on the flow of state aid and thus simulated revenues per pupil to school districts in different geographical locations. The use of a cost index increases revenues per pupil in central city school districts; this occurs because the cost indices for these school districts are substantially above one. The index also increases revenues per pupil in suburban districts, but the increase is marginal. Applied only to state aid, the cost index decreases revenues per pupil for rural areas but when applied to total expenditures leaves revenues the same.

These results indicate, among other things, that the use of cost indices has political implications. Cost indices will increase state aid, on average, to metropolitan school districts. Politically considered, the use of cost indices could be a factor in developing a city-suburban coalition on school finance matters. Since rural areas either lose state aid or are left harmless by cost indices, other factors, such as a per capita or per pupil income factor, may have to be incorporated into a formula to gain the support of rural areas for the use of cost indices. Since rural areas, in general, have lower per capita incomes they will receive relatively more state aid when income factors are part of an equalization aid formula.

V. CONCLUSIONS AND POLICY IMPLICATIONS

The most important result of the Missouri study was the development of a methodology, using basic economic theory, to construct cost-of-education indices among local school districts in a state — Missouri. The methodology, moreover, easily can be used in other states. The result is that a major advance has been made in developing the technology that will allow states to include cost-of-education equalization as well as wealth and pupil-need equalization in future school finance reform efforts.

The research in Missouri, while a major advance, is not definitive. The use of the state classification system as a quality control is crude at best. Research is in process that will use direct measures of inputs for the quality control. Future research should attempt to use output measures as control variables. In addition, a full accounting for all the limitations caused by tenure and seniority laws and capital (school building) constraints was not included in the results presented in this booklet. Those limitations also are the subject of continuing study.

However, in spite of the limitations and areas for improvement, cost-of-education indices, based on robust and stable statistical results, were developed for all the 565 school districts in Missouri. Regional cost indices, based just on teachers' salaries, also were developed.

There were, moreover, two important by-products of the cost research. First, cost indices based just on pupil-need as well as pupil weightings for various concentrations of handicapped students were developed. These results could be used as alternative ways to allocate state aid for special education. Similar indices and weighting systems could be developed for vocational and compensatory education. The fact is that the substantive economic research used to develop cost-of-education indices also provides one methodology for helping determine the weights for a pupil-weighted system of allocating categorical aids.

In addition, the research produced strong evidence on economies and diseconomies of scale. The financially optimal size for school districts in Missouri appears to be around 2500 students. The numerous small school districts with smaller student populations as well as many of the larger districts are operating under diseconomies of small and large size. What policy recommendations a state would want to make given these results could vary, but the results suggest the degree to which school district pupil size produces an efficient or inefficient school operation.

Finally, there are clearly political overtones to the use of cost indices: on

average, metropolitan districts receive more aid and nonmetropolitan districts receive less aid. While such results may complicate further the politics of school finance reform, the political problems must be weighed against the potential use of a new policy tool — cost indices — and the potential for equalizing on all three fronts — wealth, pupil-need and cost — in future school finance reforms.

APPENDIX: A BRIEF REVIEW OF PREVIOUS RESEARCH ON COST-OF-EDUCATION INDICES

As mentioned in the text, there is a significant distinction between differences in education costs and differences in education expenditures. To utilize some economic terms, differences in education expenditures are comprised of two factors: those caused by demand, i.e., quality variables, and those caused by supply, i.e., cost variables. The critical element in developing cost-of-education indices is the separation of the demand variables, which must be held constant across all school districts, from the supply variables.

There have been two basic kinds of research that have attempted to construct cost-of-education indices: those that did not use economic theory to aid the analysis and those that did use a conceptual framework based upon economics to guide the analysis. The studies in the first category[1] either made no attempt to separate demand, or quality, variables from supply variables or made essentially arbitrary assumptions about which characteristics were quality characteristics and which were supply characteristics. The studies in this category, while first-cut attempts at trying to construct cost-of-education indices, are nevertheless of limited use because of the neglect of or the arbitrariness of the treatment of the quality-versus-cost issue.

Recently a number of studies, employing the basic economic supply and demand theory, have attempted to construct cost-of-education or cost-of-teacher indices. The most significant of these studies are those conducted by Brazer[2], Frey[3] and Grubb[4].

Although Brazer specified supply and demand variables, he did so without explicitly delineating an underlying economic model of optimization, efficient resource utilization implicitly being faced by all local school boards. The result is that Brazer was unable to divide system-

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[1] See William Wasserman, *Education Price and Quality Indexes* (Syracuse: Syracuse University Press, 1963): "The National Education Association Index of 1930," "Price Indexes Compiled by Lorne H. Woollatt" and "Indexes Compiled by the New York State Department of Education."

[2] Harvey Brazer, "Adjusting for Differences Among School Districts in the Costs of Education Inputs: A Feasibility Report," *Selected Papers in School Finance 1974* (Washington, D.C.: U.S. Department of Health, Education and Welfare, Office of Education, 1975).

[3] Donald E. Frey, "The Determinants of Teachers' Salaries in New Jersey" (Washington, D.C.: The National Urban Coalition, May 28, 1976).

[4] W. Norton Grubb, "Identifying Teacher Supply Functions and Constructing Cost Indices: Methodological Explorations with California Unified School Districts," Preliminary draft to the U.S. Office of Education under contract OEC-300-75-0320.

ically the demand variables from the supply variables because the variables he used simultaneously affected the determination of wages, the numbers of teachers employed, the quality of teachers, etc. He was therefore forced to make alternative assumptions about which variables were choice variables (demand and quality variables) and, ultimately, was forced to make essentially arbitrary decisions on which variables to put into the two categories. Thus, his research is subject to the same criticism of the earlier studies discussed above.

Frey found that the major determinant of teacher salaries was the wages that were paid for alternative jobs requiring similar training in the same labor market. Although Frey's research separated quite clearly the demand and supply variables, his results document the obvious rather than providing any new insights. His alternative wage variable is essentially a labor market regional variable. His finding, therefore, indicates that different labor markets within a state play an important role in determining teacher salaries, a point most economists readily would admit. Frey also used the district as the unit of analysis in his work as well as demand variables that were proxies for quality measures rather than direct measures of teacher or education quality. His research would have been enhanced greatly if it had used teachers as the unit of analysis and measured directly the various qualities of teachers.

Grubb has conducted one of the most complete studies of education cost differentials. His research specified clearly the optimization problem underlying his model of supply and demand for school inputs, which enabled him to separate out systematically the demand and supply factors. There are a few minor criticisms of his model: his use of the school tax rate as the variable indicating a local preference for school inputs, which is open to a "tax rate illusion" criticism, and his use of a fixed pupil-teacher ratio in the calculation of the index. A major shortcoming of his work was its not accounting for constraints on local decision makers in declining enrollment districts caused by seniority and tenure provisions.

The major advances made in the research reported in this booklet are a direct measure of teacher quality as opposed to any proxy measures and the development of a model to account for the shortcomings in the Grubb work.

Education Commission of the States

The Education Commission of the States is a nonprofit organization formed by interstate compact in 1966. Forty-five states, Puerto Rico and the Virgin Islands are now members. Its goal is to further a working relationship among governors, state legislators and educators for the improvement of education. This report is an outcome of one of many Commission undertakings at all levels of education. The Commission offices are located at 300 Lincoln Tower, 1860 Lincoln Street, Denver, Colorado 80203.